INTERNATIONAL JOURNAL OF PEST MANAGEMENT, 1997, **43**(1) 59–62

Evaluation of methyl anthranilate as a woodpecker repellent

(*Keywords:* chemical control, damage, feeding, methyl anthranilate, repellent, woodpecker)

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Abstract. We evaluated the effectiveness of ReJex-iT™ TP-40, containing 40% methyl anthranilate (MA) for deterring woodpeckers from food and from damaging wood sidings of buildings. During December 1993–February 1994 we conducted three 2-week trials at four sites using six pairs of feeders containing untreated or TP-40-treated suet (5·0, 2·5, or 1·25% g/g). We then placed 10 (1995) and four (1996) pairs (1 each TP-40-treated and control) of boxes with wood siding containing untreated suet at seven and four sites with known woodpecker activity for 2–3 weeks to assess damage to the siding. We also applied TP-40 to woodpecker-damaged wood siding of 14 residential buildings during 1994–1996. Suet-eating birds, primarily downy woodpeckers (*Picoides pubescens* Linnaeus), were repelled ($P < 0{\cdot}01$) by treated suet at all concentrations compared with untreated suet. By contrast, damage (primarily by downy woodpeckers) to wood siding on untreated and TP-40-treated boxes was similar ($P \geq 0{\cdot}32$) in both years. Also, 5 of 10 buildings treated with TP-40 received woodpecker damage in areas treated previously. We conclude that TP-40 deters woodpeckers from food but does not reduce woodpecker damage to wood siding. This difference in repellency is likely to have been a consequence of rapid degradation of TP-40 from siding (49% in 3 days) and the fact that woodpeckers do not ingest wood, which minimized their exposure to TP-40. We conclude that chemical repellents will generally be ineffective in reducing woodpecker damage to wood, and that other techniques including exclusion, frightening devices, and alternate forms of wood siding (e.g. wood composites) should be developed.

1. Introduction

Woodpeckers cause on average $300 in damage to affected houses, and they cause millions of dollars of damage annually in the United States (Craven, 1984). Damage results from the birds' excavation and drumming activities on outside walls, window sills and trim (Evans *et al.*, 1983; Marsh, 1983; Craven, 1984). Woodpeckers also cause considerable damage to utility poles (Pfitzenmeyer, 1956; Dennis, 1964; Stemmerman, 1988).

Home-owners use several methods to reduce woodpecker damage including exclusion and frightening devices, tactile repellents, suet as an alternate attractant and lethal control (Marsh, 1983). However, efficacy of these techniques has not been quantified and many of these techniques are unattractive to home-owners. Lethal control requires federal and state permits in the United States. In addition, mechanical barriers (e.g. wire or plastic mesh) and creosote on utility poles have limited application or success in reducing woodpecker damage (Rumsey, 1970; Stemmerman, 1988). Recently, US Department of Agriculture Animal Damage Control (USDA/ADC) biologists indicated a high priority for development of methods to alleviate woodpecker damage to structures (ranked 9 among 66 wildlife damage problems) (Packham and Connolly, 1992).

Methyl anthranilate (MA) is a GRAS-listed (generally recognized as safe) human food flavouring (Jenner *et al.*, 1964; Code of Federal Regulations, 1988) with bird repellent properties (e.g. Dolbeer *et al.*, 1991, 1993; Belant *et al.*, 1995; Cummings *et al.*, 1995). TP-40, an oil-based formulation containing 40% MA, is currently registered by the US Environmental Protection Agency (Reg. No. 58035-7) to repel birds from water in landfills, tailing ponds and commercial/industrial impoundments. Our objectives were to: (1) evaluate the efficacy of TP-40 as a feeding repellent for woodpeckers (and other suet-eating birds), and (2) determine if woodpeckers could be deterred from damaging TP-40-treated wood siding in controlled field experiments and on buildings. Our goal was to assess the potential of TP-40 for reducing woodpecker damage to house siding and utility poles.

2. Materials and methods

2.1. Suet trials

Suet feeding trials were conducted from December 1993–February 1994 in Erie County, Ohio, at four residences 6–10 km apart where suet was already being fed to woodpeckers; primarily downy (*Picoides pubescens* Linnaeus), hairy (*P. villosus* Linnaeus) and red-bellied (*Melanerpes carolinus* Linnaeus). Suet feeders, each constructed from two pieces (18 cm × 20 cm) of vinyl-coated poultry wire (2·5 cm hex mesh) fastened together to enclose about 300 g of suet, were attached by hog rings to wires wrapped around trees 1·5–3 m above the ground. Two of the residences received one pair of holders (one holder randomly assigned to contain TP-40-treated suet and the other untreated suet) and two of the residences received two pairs of holders. Holders within a pair faced the same direction on trees 3–5 m apart and pairs of holders at the same site were >5 m apart.

Raw beef suet was ground in a meat-grinder and rendered at >21 C. All solid material was strained and liquid suet was poured into 2·5 cm deep pans to solidify. The suet was then cut into blocks (11·5 cm × 11·5 cm × 2.5 cm) weighing about 300 g. Suet blocks were impregnated with TP-40 at three concentrations (5·0, 2·5, and 1·25% g/g) by mixing TP-40 with suet blocks melted at a minimum melting point (to avoid volatilization of TP-40). Treated suet was poured into moulds (11·5 cm × 11·5

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cm × 2·5 cm) to resolidify. Before placing suet blocks in the holders, a sheet of plastic (12·7 cm × 12·7 cm) was inserted against the back of the holder to prevent the suet from contaminating trees. Baited holders were weighed to the nearest 0·1 g before being attached to trees.

Three 14-days tests were conducted, one each using 5·0, 2·5, or 1·25% TP-40-treated suet. Alternative suet was not available during the tests. When a subsequent test at any site did not immediately follow the previous test, a pair of holders with untreated suet blocks were provided for the birds during the non-test period.

During each test, pairs of holders at each site were observed for 1 h between 0800–1630 on days 7 and 14 post-treatment to record duration (in seconds) of bird use (perched on or immediately adjacent to holder) by species. Positions of treated and untreated holders were also alternated on day 7 and removed on day 14. Holders were then re-weighed to the nearest 0·1 g. If >90% of either suet block in a pair was removed during a test, the holders and remaining suet were weighed with a new pair of holders (with fresh treated and untreated suet).

To maintain independence among sites, mean values of bird presence and suet consumption were calculated for the two sites with two pairs of holders. Three-factor ANOVA (analysis of variance) (2 treatment levels, 3 tests, 4 locations) using log-transformed data (SAS Institute Inc., 1988) were used to compare bird presence at feeders (s) and amount (g) of suet removed for TP-40 treated and untreated suet.

2.2. *Wood siding trials*

We conducted the first trial during March–April 1995 at 7 sites in Erie County, Ohio, where suet was already available to woodpeckers. Wood boxes (30·5 cm × 12·5 cm × 6·3 cm) were constructed with a front panel (29·0 cm × 12·5 cm × 0·7 cm) of western red cedar (*Thuja plicata)* siding. We placed ⩾300 g of untreated suet in each box before attaching the front cedar panel. Suet was exposed through a 1·4 cm diameter hole drilled in the centre of the front panel 10 cm from the top. The hole was filled initially with suet to attract woodpeckers to feed and to encourage damage.

At each site, 1–2 pairs (10 pairs total) of identical wood boxes containing suet were attached to trees 1·5–3 m above ground with each pair oriented similarly. Paired boxes were 3–5 m apart; pairs of boxes at the same site were ⩾35 m apart.

Boxes were checked for damage at least once each week. Once woodpeckers had damaged any part of both boxes or removed suet from the holes, one box was randomly selected and treated with TP-40 (applied with a brush to saturation over the entire external surface); the other box remained untreated. Prior to treatment, damaged front panels from each pair were replaced with similar undamaged panels and suet was replaced. If other parts of the boxes were damaged, the pair of boxes was replaced with boxes without damage. Positions of the treated and untreated boxes were alternated at 7-day intervals then removed 21-days post-treatment. Boxes at each site were observed for ⩽1 h/week post-treatment between 0800–1630 to record duration of bird use by species.

The area (cm^2) damaged on each box was determined by tracing the perimeter of the damaged area onto a clear acetate sheet before measuring with a compensating polar planimeter. We summed the areas for boxes with >1 damaged area.

We used *t*-tests on log-transformed data (SAS Institute, Inc., 1988) to compare the area damaged on the front panels and entire boxes untreated and treated with TP-40. Mean values of damage to untreated and treated boxes were calculated for the 3 sites with 2 pairs of boxes prior to analyses.

We conducted the second wood siding trial during February–April 1996. We constructed four triangular-shaped boxes, each with two 22 cm × 28 cm panels of western red cedar siding. One 28 cm edge of each of two panels were fastened together to form a 90 angle. Sheet metal was used to cover the edges of the panels and the top, bottom and third side of the boxes. A 1·4 cm hole was also drilled in the centre of each panel. We filled the holes with suet and attached a 0·1 l cup with suet to the inside of each panel behind the hole.

At each of 4 sites >10 km apart, we attached a box to a tree 1·5–3 m above ground. Untreated suet in a holder was available for >2 weeks prior to box placement. Boxes were checked at least once each week. When at least 1 panel received damage, we selected the panel with greatest damage and applied TP-40 with a brush to saturation.

We made a 2 cm × 2 cm grid on a clear acetate sheet to assess damage by overlaying the grid on the panels and counting the number of cells receiving damage. Using the grid, we recorded the number of cells with damage and the number of cells with holes excavated on days 1–3, 7 and 14. We also conducted observations at each box for 1 h each week to determine duration of bird use by species. We used repeated ANOVA measures (SAS Institute, Inc., 1988) on log-transformed data to determine if the total mean number of cells damaged and number of cell with holes excavated differed among untreated and TP-40-treated panels.

To determine the rate at which TP-40 volatilized from wood siding, we cut 6 pairs of identical 10 cm × 6 cm blocks of western red cedar siding. We initially weighed all blocks then randomly selected one block from each pair and with a brush applied 1·5 g TP-40. Blocks were maintained indoors at about 20 C and were reweighed on days 1–3, 7, 21, and 35. We adjusted for moisture loss using the weights of the six untreated blocks. We used repeated measures ANOVA to determine if the amount of TP-40 present in the blocks differed among days. Tukey tests were used to isolate differences in means among days. We also measured the maximum depth (mm) to which TP-40 penetrated the blocks.

2.3. *Residential building trials*

We evaluated TP-40 on buildings with wood siding from December 1994–May 1995 and October 1995–May 1996 in northern Ohio. We inspected buildings of owners that reported damage to the USDA/ADC office in Sandusky, OH. Buildings were treated by applying TP-40 with a brush to saturation to damaged areas and a perimeter of up to 8 cm around the damaged areas. We recorded size of the treated area and when possible, type of wood damaged. Each entire building was examined and photographed monthly to determine if woodpeckers had caused new damage in treated or untreated areas. All new damage located was treated. In addition, damaged areas on

all buildings during 1994 – 1995 were retreated 5 months after initial treatment. In 1995 – 1996, damaged areas on buildings were retreated every three months from the date of first treatment.

3. Results

3.1. Suet trials

Birds were present at suet holders during 11·4% of the 24 h of observation. Downy woodpeckers were observed most frequently (81% of total bird use), followed by red-bellied (6%) and hairy woodpeckers (4%). Overall, birds spent 92% of the time at holders with untreated suet compared to 8% at holders with treated suet (Figure 1) ($F = 16{\cdot}67$; 1,3 df; $P < 0{\cdot}01$).

Overall, birds consumed a mean of 10·2 g of suet/treated block, less ($F = 46{\cdot}65$; 1,6 df; $P < 0{\cdot}01$) than the 129·8 g consumed/untreated block. Birds consumed 33, 40, and 6 times more untreated suet than treated suet in the 5%-, 2·5%- and 1·25%-TP-40 tests, respectively (Figure 1) ($F = 3{\cdot}53$; 2,3 df; $P = 0{\cdot}05$).

3.2. Wood siding trials

During the 1995 trial, birds were present at boxes during 8·5% of the 11·75 h of observation. Downy woodpeckers were observed most frequently (90% of total bird use); hairy, red-bellied and pileated woodpeckers (*Dryocopus pileatus* Linnaeus) each comprised 2 – 3% of observations.

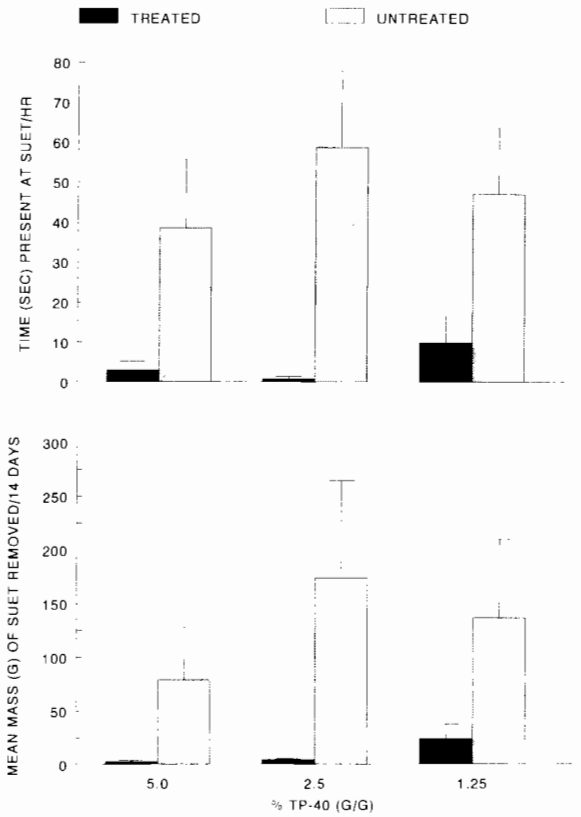

Figure 1. Bird, primarily woodpecker, presence at TP-40-treated and untreated suet during 12 h of observations and total suet consumed in each of 3 14-day tests, Erie County, Ohio, December 1993 – February 1994. Capped vertical lines represent 1 standard error.

Suet in the holes was removed from all 20 boxes; 17 boxes, including 9 front panels, received damage. The area (cm^2) damaged ($\bar{X} \pm$ SE) was similar ($t = 0{\cdot}62$; 12 df; $P = 0{\cdot}54$) between front panels of boxes untreated ($3{\cdot}9 \pm 2{\cdot}8$) and treated ($1{\cdot}8 \pm 1{\cdot}7$) with TP-40. The area damaged for entire boxes untreated ($28{\cdot}5 \pm 14{\cdot}5$) and treated ($15{\cdot}1 \pm 6{\cdot}3$) with TP-40 was also similar ($t = -0{\cdot}03$; 12 df; $P = 0{\cdot}98$).

During the 1996 trial, birds were present at boxes during 4·3% of the 12 h of observation. Downy woodpeckers were observed most frequently (97% of total bird use).

All 8 panels received damage. The total mean number of cells damaged was similar ($F = 0{\cdot}21$; 1,6 df; $P = 0{\cdot}66$) for untreated ($2{\cdot}6 \pm 0{\cdot}6$) and TP-40-treated ($3{\cdot}4 \pm 1{\cdot}2$) panels (Figure 2); there was no interaction of day and treatment ($F = 0{\cdot}26$; 4,24 df; $P = 0{\cdot}75$). The total mean number of cells with holes excavated in untreated ($0{\cdot}4 \pm 0{\cdot}3$) and treated ($0{\cdot}9 \pm 0{\cdot}3$) panels was also similar ($F = 1{\cdot}20$; 1.6 df; $P = 0{\cdot}32$); there was no interaction of day and treatment ($F = 0{\cdot}42$; 4.24 df; $P = 0{\cdot}64$).

TP-40 volatilized rapidly ($F = 1293{\cdot}76$; 5·25 df; $P < 0{\cdot}01$) from the 10 cm × 6 cm cedar panels (Figure 3). The amount of TP-40 present declined ($P < 0{\cdot}05$) from day 1 (27% loss) through day 21 (89% loss). TP-40 concentrations remained constant from days 21 – 35 ($P > 0{\cdot}05$). TP-40 penetrated the cedar blocks to the first glue barrier, 1 mm from the surface.

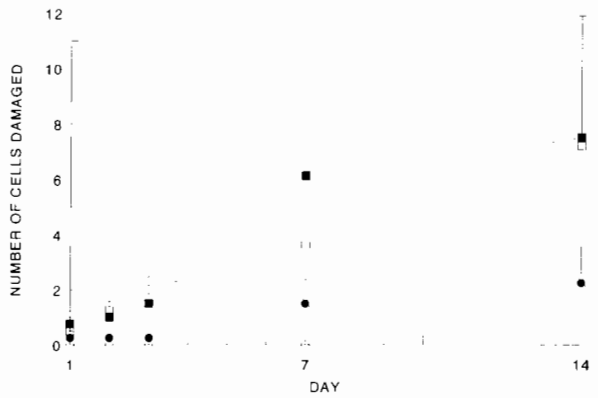

Figure 2. Woodpecker damage to TP-40-treated (solid symbols) and untreated (open symbols) western red cedar panels during a 14-day test, Erie County, Ohio, February – April 1996. Squares represent total mean number of 2 cm × 2 cm cells damaged; circles represent total mean number of cells with holes excavated. Capped vertical lines represent 1 standard error.

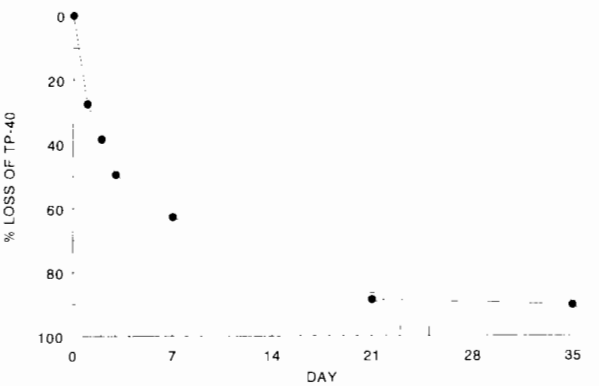

Figure 3. Mean percent loss of TP-40 from six 10 cm × 6 cm panels of red cedar siding. Panels were maintained indoors at 20 C and were adjusted for weight loss using 6 untreated red cedar panels. Capped vertical lines represent 1 standard error.

3.3. *Residential building trials*

We treated 9 buildings in 1994–1995 and 5 buildings in 1995–1996. The total are treated for initial or new damage outside of previously-treated areas was 25·3 m^2 (15·6 m^2 in 1994–1995, 9·8 m^2 in 1995–1996). For both years combined, 10 of the 14 structures received additional damage, 5 outside previously-treated areas on other sides of buildings and 5 within previously-treated areas. The total treated area that was re-damaged was 0·7 m^2 or 2·8% of the total treated area. All post-treatment damage in previously-treated areas occurred within 7–30 days of treatment.

The frequency and type of wood siding damaged included 8 cedar (3 were painted and 5 stained), 2 fir (1 painted, 1 stained), 1 redwood (painted) and 1 pine (painted). Damage to structures included complete to partial excavation of cavities and feeding along core gaps in the siding.

4. Discussion

Birds, primarily downy woodpeckers, were repelled from suet treated with 1·25–5·0% TP-40. In contrast, woodpeckers were not repelled by TP-40 applied to wood siding. This difference in repellency is likely to have been a consequence of the amount of MA contacting trigeminal receptors in the oral cavities of the woodpeckers (see Mason *et al.*, 1989; Mason and Clark, 1992). TP-40 in suet ingested by woodpeckers would undoubtedly contact trigeminal receptors in the mouth which likely induced repellency. Woodpeckers do not ingest wood removed to access food sources or to excavate cavities; thus, oral trigeminal receptors were probably not affected. Also, TP-40 applied to wood siding remains at or near the surface of the siding and volatilizes rapidly. Thus, TP-40 at the site of damage was likely volatilized soon after damage was initiated.

Clark (1996) demonstrated with European starlings (*Sturnus vulgaris*) that odour is not important in the avoidance response to trigeminal repellents like MA (TP-40), even after direct oral contact with the repellent. Also, trigeminal repellents have been determined not to cause conditioned avoidance (Belant *et al.*, 1996; Clark, 1996). Thus, even if TP-40 applied to wood siding was repellent to woodpeckers, the birds would continuously sample (damage) treated areas on buildings, if the stimulus for causing damage remained.

Because woodpeckers do not consume wood during drumming, foraging and cavity-excavating activities, it is unlikely that chemical repellents, at least trigeminal repellents, applied to wood siding and utility poles will be effective in reducing woodpecker damage. Additional research should focus on other techniques to reduce woodpecker damage such as exclusion, frightening devices, capture and relocation and development of alternate wood sidings (e.g. wood composites).

Acknowledgements

P.F. Vogt (RJ Advantage, Cincinnati, Oh., USA) provided the TP-40; P. Albrethsen, R. and R. Barrett, J. Bernard, U. Bessler, J. Boos, R. Booth, A.L. Bower, J. Denas, B. and C. Englert, B. and S.K. Ickes, E. Kirby, K. Palmerton, S. Reddy, M.R. and W. Rutger, R. St. James, E. and H. Schedley, and D. Simpson allowed access to study sites. E.C. Cleary, J.C. Hovis, S. K.Ickes, M.R. Rutger, L.A. Tyson, and S.E. Wright provided field assistance.

References

BELANT, J.L., GABREY, S.W., DOLBEER, R.A. and SEAMANS, T.W., 1995. Methyl anthranilate repels mallards and gulls from water. *Crop Protection*, **14,** 171–175.

BELANT, J.L., SEAMANS, T.W., TYSON, L.A., and ICKES, S.K., 1996. Repellency of methyl anthranilate to pre-exposed and naive Canada geese. *Journal of Wildlife Management*, **60,** 923–928.

CLARK, L., 1996. Trigeminal repellents do not promote conditioned odor avoidance in European starlings. *Wilson Bulletin*, **108,** 36–52.

CODE OF FEDERAL REGULATIONS, 1988. *Food and Drugs*, Vol. 21, Part 182. 60, p.391.

CRAVEN, S.R. 1984. Woodpeckers: a serious suburban problem? *Proceedings Vertebrate Pest Conference*, **11,** 204–210.

CUMMINGS, J.L., POCHOP, P.A., DAVIS, J.E., JR, and KRUPA, H.W., 1995. Evaluation of ReJex-iT AG-36 as a Canada goose grazing repellent. *Journal of Wildlife Management*, **59,** 47–50.

DENNIS, J.V. 1964. Woodpecker damage to utility poles: with special reference to the role of territory and resonance. *Bird-Banding*, **35,** 225–253.

DOLBEER, R.A., CLARK, L., WORONECKI, P.P. and SEAMANS, T.W. 1991. Pen tests of methyl anthranilate as a bird repellent in water. *Proceedings Eastern Wildlife Damage Control Conference*, **5,** 112–116.

DOLBEER, R.A., BELANT, J.L. and CLARK, L. 1993. Methyl anthranilate formulations to repel birds from water at airports and food at landfills. *Proceedings Great Plains Wildlife Damage Control Conference*, **11,** 42–53.

EVANS, D., BYFORD, J.L. and WAINBERG, R.H. (1983). A characterization of woodpecker damage to houses in east Tennessee. *Proceedings Eastern Wildlife Damage Control Conference*, **1,** 325–329.

JENNER, P.M., HAGEN, E.C., TAYLOR, J.M., COOK, E.L. and FITZHUGH, O.G. 1964. Food flavourings and compounds of related structures. I. Acute oral toxicity. *Food Cosmetics and Toxicology*, **2,** 327–343.

MARSH, R.E. 1983. Woodpeckers. In R.M. Timm (ed) *Prevention and Control of Wildlife Damage* (Lincoln: University of Nebraska), pp. E79–84.

MASON, J.R., ADAMS, M.A. and CLARK, L., 1989. Anthranilate repellency to starlings: chemical correlates and sensory perception: *Journal of Wildlife Management*, **53,** 55–64.

MASON, J.R. and CLARK, L. 1992. Nonlethal repellents: the development of cost-effective practical solutions to agricultural and industrial problems. *Proceedings Vertebrate Pest Conference*, **15,** 115–129.

PACKHAM, C.J. and CONNOLLY, G. 1992. Control methods research priorities for Animal Damage Control. *Proceedings Vertebrate Pest Conference*, **15,** 12–16.

PFITZENMEYER, H.T. 1956. Life history and behavior patterns of the pileated woodpecker relative to utility lines. *M.S. thesis*, (State College: Pennsylvania State University), pp. 112.

RUMSEY, R.L. 1970. Woodpecker nest failure in creosoted utility poles. *Auk*, **87,** 367–369.

SAS INSTITUTE INC. 1988. *SAS/STAT User's Guide*, 6.03 edition (Cary, North Carolina: SAS Institute Inc.), pp. 1028.

STEMMERMAN, L.A. 1988. Observation of woodpecker damage to electrical distribution line poles in Missouri. *Proceedings Vertebrate Pest Conference*, **13,** 260–265.